

WHAT IS CLAIMED:

1. A method of controllably providing heating in a microfluidic device, comprising:
 - applying a first selectable current through a resistive heating element in thermal contact with the microfluidic device;
 - applying a second selectable current through the resistive heating element, wherein the second selectable current has a different frequency than the first selectable current,
 - detecting at least one characteristic indicative of a temperature of the resistive heating element using the second selectable current; and
 - using the one characteristic to control the selectable current to elevate the temperature of the resistive heating element.
2. The method of claim 1, further wherein: the first selectable current comprises a higher frequency signal; and the second selectable current comprises a lower frequency signal.
3. The method of claim 1, further wherein: the first selectable current comprises a higher frequency signal of about 10 kHz; and the second selectable current comprises a lower frequency signal of about 10 Hz.
4. The method of claim 1, further wherein: the second selectable current is used to measure the resistance of the resistive heating element.
5. The method of claim 1, further wherein: the first selectable current comprises a frequency signal of greater than about 300 Hz.
6. The method of claim 1, wherein the resistive heating element is disposed in a channel in the microfluidic device.
7. The method of claim 1, wherein the resistive heating element is disposed near a channel in the microfluidic device.
8. The method of claim 1, comprising repeatedly cycling a temperature of a material in a channel of the microfluidic device between a first temperature and a second temperature.

9. The method of claim 8, wherein the material comprises reagents for performing a nucleic acid amplification reaction.
10. The method of claim 9, wherein the nucleic acid amplification reaction is selected from the group consisting of a polymerase chain reaction and a ligase chain reaction.
11. The method of claim 1, wherein the first selectable current comprises an alternating current and the second selectable current comprises a direct current.
12. The method of claim 1, wherein the first selectable current comprises a direct current and the second selectable current comprises an alternating current.
13. The method of claim 1, wherein the microfluidic device comprises a fluid-filled channel, and further comprising the step of maintaining a global temperature of the microfluidic device at a selected level above or below ambient temperature.
14. A system for elevating temperature in at least a portion of a fluid-filled channel disposed in a substrate, to a selected elevated temperature, comprising:
a resistive heating element disposed on the substrate;
a controllable effector power source able to apply a first controllable signal through a fluid in the at least a portion of the fluid-filled channel;
a probe signal source able to apply a second voltage signal through a fluid in the at least a portion of the fluid-filled channel, wherein the second voltage signal has a different frequency than the first controllable signal;
a probe signal detector able to detect at least one characteristic indicative of a fluid temperature using said probe signal;
and a controller able to use said at least one characteristic to provide a control signal varying said controllable effector power source.
15. The system of claim 14, further wherein: the first controllable signal comprises a higher frequency, higher voltage signal; and the probe signal comprises a lower frequency, lower voltage signal.

16. The system of claim 14, wherein the first controllable signal comprises a higher frequency signal of about 10 kHz; and the probe signal comprises a lower frequency signal of about 10 Hz.

17. The system of claim 14, wherein the probe signal is used to measure resistance of the resistive heating element.

18. The system of claim 14, wherein the first controllable signal comprises a frequency signal of greater than about 300 Hz.

19. The system of claim 14, wherein the resistive heating element is disposed in the fluid filled channel.

20. The system of claim 14, wherein the resistive heating element is disposed near the fluid filled channel.